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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

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TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E. C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed in signed articles are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

TRAVEL AND RESEARCH.

At the Imperial Botanical conference held in July, 1924, the question of the possibility of an interchange of Botanists between the different parts of the Empire formed the subject of discussion and the question was referred to a sub-committee of the Executive Committee of that Conference. The report of this sub-committee has recently been submitted to, and approved by, the Executive Committee. The report recognises the difficulties in the way of any effective interchange to be sufficiently great to render such interchange impracticable and recommends that "no further steps be taken in regard to the "exchange of Botanists in different parts of the "Empire where such an exchange would imply "that each of an exchanging pair would be "charged with the duties of the other."

The recognition of the impracticability of a direct interchange of Botanists, however, is associated with a recognition of the desirability of doing everything possible to render easy the visits of British Botanists to the Dominions and Colonies and *vice versa*. As regards the former purpose, the visit of British Botanists overseas, the permanence of the Imperial Botanical Conference organisation permits much to be done and it is proposed to maintain a list of workers desirous of proceeding overseas with particulars as to period and conditions under which they can be spared, supported by the heads of the institution to which they are attached. There is at the present time a considerable amount of information available as to the Universities of the Empire. This is collected in the Universities Yearbook, issued by the Universities Bureau of the British Empire, an organisation whose first duty is "to collect University information from "every part of the Empire and to put it in a "suitable form for easy distribution." Such information, however, requires to be amplified, mainly in the direction of including information regarding institutions other than Universities, such as Government Departments, where facilities for research are available and for providing introductions.

As regards the latter purpose, the visit of overseas Botanists to England, the Universities Yearbook provides detailed information with respect to English Universities, the facilities offered and the regulations for degrees but, here also, there are numerous institutions associated with no University which offer facilities attractive

to overseas workers and it is suggested that the permanent committee should form a bureau to which intending visitors could apply for information.

The financial aspect is not so readily dealt with for, generally speaking, the Universities are not staffed by men overendowed with wordly goods and to meet the cost involved is a matter of serious consideration. In part this can be met by liberality in the matter of pay during absence from the employing institution but in many cases this will be insufficient. Attention is drawn to the fact that the Australian steamship lines have granted eight first class free passages annually to graduates of the Universities of Great Britain and Ireland visiting Australia or New Zealand for the purpose of holding temporary teaching posts or of prosecuting research into problems connected with the development and resources of these countries. This is an example which it is hoped lines linking Great Britain with other portions of the Empire might follow. There are also available a number of University Grants to enable research workers to study overseas, but these are, for the most part, intended for students who have only just taken their degrees and are not available for more advanced workers. In this direction, therefore, there is much to be accomplished if adequate opportunity to travel is to be available to advanced workers.

In this matter the Botanical Conference have taken the first step to fill in a gap in the scientific organisation of the Empire. Clearly, it is a gap which is not limited to the field of Botany but applies to all sciences. It is a gap which must be filled if the needs of our expanding Empire are to be adequately met. It is, moreover, a direction in which the British Empire lags behind others with lesser overseas commitments than ourselves. The example of the Dutch in Buitenzorg is too well known to require detailed relation ; yet the Dutch are not content with making Buitenzorg a centre which Dutch scientists make a habit of visiting for the purpose of research. In the short history of the Imperial College we have been visited by Dutch scientists touring for the purpose of scientific enquiry. America offers a still wider example and in addition to supporting research institutions overseas, as in the Philippines, which, if the British Standard is accepted as adequate, are altogether in excess of requirements, provides a large number of travelling research fellowships available to men long past the student stage, men, in fact, whose scientific reputations are established. Germany also, before the war, had adopted a similar policy and by the establishment of the Amani Institute in Tanganyika territory, had become possessed of a station comparable to Buitenzorg. From these instances there is only one reasonable inference, namely, that the provision made by the British Empire is not adequate to the needs of that Empire.

Until recent years the Royal Botanic Gardens at Peradeniya provided the main tropical station to which research workers, especially those interested in the Botanical Sciences, could within the Empire turn to meet their requirements. Recently, however, the establishment of the Imperial College of Tropical Agriculture in Trinidad has provided a second station. It is part of the policy of this College to provide to such workers, all facilities that are possible, within its power. At the present time financial considerations have to be considered but free use of the Laboratories and equipment are available and payment is only asked for any special requirements, nevertheless, in its short history it has not entirely failed to serve this function.

Between February, 1923 and January, 1924, Dr. Farnell as Research Chemist of the British Empire Sugar Research Association made this College his headquarters ; facilities are now being provided for the conduct of the Chemical studies in connection with the Froghopper investigation and lastly, Dr. J. S. Dunkerly, Professor of Zoology, Manchester University and formerly Lecturer in Parasitology at Glasgow University is spending the three vacation months working at the College. The advantages of such visits is not, by any means onesided ; while we hope our visitors will carry away with them pleasant memories of a time not ill spent, we at the College undoubtedly derive benefit ourselves and we hope to welcome such visitors in ever increasing numbers.

GRENADA.

SOME interest attaches to the Report on the Agricultural Department of Grenada for 1925, issued by the Imperial Commissioner of Agriculture for the West Indies, because of the fact that, locally, there is an expectation of the development of a fruit growing industry. Planters and agriculturists in general are showing considerable interest and activity in the cultivation of pine-apples, banana and citrus fruits, the latter, for the first time in the history of the Colony, having been exported during the year to the Dominion of Canada. In the case of pine-apples, there are already some 30 acres of land under cultivation dealing with the agricultural exports from the Island, the Report shows that the value of exported produce exhibited an increase of £63,359 over 1924, the great increase in value being attributed to the high price of 74 cents per lb. paid for mace during the year under review, as against 50 cents per lb. paid for this commodity in 1924. Nutmegs form the Island's principal industry and a quantity of 2,437,344 lb. to the value of £145,861 was exported during the year. Cocoa, too, continues to show an appreciable increase in output, 6,392 bags being exported over and above the previous year's total of 47,064 bags.

Subscriptions to Lord Milner's Appeal for £100,000 as an endowment fund for the Imperial College of Tropical Agriculture should be addressed to the Secretary, Imperial College of Tropical Agriculture or to the bankers of the Fund, the Colonial Bank, 29, Gracechurch Street, E.C.

Photograph by THE NEW BUILDING OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE. *L. Tucker.*

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THE BANANA TRADE.

WE have just received a copy of the 3rd report of the Imperial Economic Committee which deals with the problem of fruit. A consideration of the general conclusions will appear in a later number of *Tropical Agriculture*. We summarize here the report on Bananas, essentially a tropical product.

Para. 1.—The Banana is found throughout the whole tropical belt. It is cultivated in the Central American States, Colombia, Brazil and in the West Indies especially Jamaica. It is grown as far north as the Canary Islands; in East and West Africa it grows in a semi-wild state where it frequently forms almost the sole article of diet of the local native population. In the East it occurs in Burma, Assam, Indo-China, China and as far south as Queensland. It grows in various islands in the Pacific and is extensively produced in the Philippine Islands.

Para. 2.—Production for export is limited to a few tracts; Central America and the West Indies supply the United States and the United Kingdom; the Canary Islands export to the United Kingdom and certain European markets; Formosa supplies Japan and China; Queensland supplies Australia, while Fiji mainly supplies New Zealand.

Para. 3.—While there are vast areas capable of producing bananas on a commercial scale and provision of shipping presents no serious difficulty, the limitation is the fact that the maximum period for carriage under refrigeration is 21 days.

Para. 4.—An increased supply to temperate countries is justified by the high nutrition value. Banana flour can be used to a limited extent as a substitute for wheaten flour and the possibility of a more extended use of bananas in the dried form is being investigated.

Paras. 5-7.—There are only two main species of commercial value, *Musa sapientum* to which belongs the Gros Michel and *Musa Cavendishii*, the Canary banana. The former yields a bunch weighing 50-80 lbs. with 6 to 9 or more hands, and 70-180 fruits; the latter a bunch of 25-65 lbs. with 125-200 fruits.

Para. 8.—The chief importing countries are the United States, the United Kingdom, the Continent of Europe, Canada and Japan. The banana trade has drifted into certain channels not wholly advantageous to the Empire. British (Jamaican) supplies go largely to foreign markets while the United Kingdom market is almost entirely dependent on foreign supplies.

Paras. 9-13.—The United States market absorbs some 45-47 million bunches. France, Belgium and Holland are taking a rapidly increasing supply, in 1924 amounting to 64,500 metric tons (some 2.5 million bunches). The United Kingdom takes between 11-12 million bunches of which some 24 per cent. come from the Canaries, 60 per cent. from Central America and Colombia and 16 per cent. from the British West Indies.

Para. 14.—The total value of the Banana Trade of the United Kingdom is between £5.5 and £6 million, per annum.

Para. 15.—In 20 years the percentage of the supplies from Central America and Colombia has risen from 14 to over 60.

Para. 16.—The Canary banana is imported without refrigeration as deck cargo and is handled through the ordinary marketing channels.

Para. 17.—The marketing of bananas from the Western Hemisphere is under the control of one company, Messrs. Elders and Fyffes over 99 per cent. of whose shares are held in the United States and over 83 per cent. by the United Fruit Company. The United Fruit Company is a large grower on its own account; the fruit is shipped to a limited number of ports in the United Kingdom and distributed in its own wagons to wholesalers and retailers. In effect the monopoly enables the Company to ration the market, apart from the importation of Canary bananas, to such extent as it thinks fit.

Paras. 18-19.—The United Kingdom is capable of absorbing a larger supply of bananas, its consumption being 30 per capita against 50 per capita for the United States of America. At the same time the Continental market is rapidly expanding. Under the trade agreement between Canada and the West Indies arrangements for transport of bananas from the West Indies are made and then is there ample scope for a largely increased production in the Empire.

Para. 20.—The problem of Empire production falls into three sections geographically:

(1) Jamaica and British Honduras where cultivation is already in existence.

(2) Other British West Indian Colonies, mainly Trinidad, St. Lucia, Grenada, possibly Dominica and British Guiana.

(3) British West African Colonies.

Para. 21.—In each case the problem is again sub-divided into:

(1) Production.

(2) Transport to the United Kingdom.

(3) Marketing in the United Kingdom.

Para. 22.—In Jamaica marketing is in the hands of a monopoly; in British Honduras output has been seriously reduced by Panama disease. In St. Lucia and Grenada cultivation on a limited scale is taking place; in Trinidad and British Guiana it depends upon the discovery of a type immune to Panama disease.

Paras. 23-25.—Shipping facilities wait on production and production is the crux of the problem, but for Jamaica the problem is one of production in the neighbouring colonies.

Paras. 26-27.—Jamaican production is fairly constant, the main cause of variation being hurricanes.

Paras. 28-30.—The bulk of Jamaican fruit is marketed in the United States of America where it is taken without refrigeration. The United

Fruit Company are the chief handlers of the Jamaican crop, handling five out of twelve million bunches. Only 1.6 out of twelve million bunches were shipped from Jamaica to the United Kingdom.

Paras. 31-32.—The marketing of Jamaican bananas in the United Kingdom was started by Messrs. Elder Dempster, a line subsidised in 1900 by His Majesty's Government. Losses due to unacceptability of the class of fruit and to lack of knowledge of conditions for transport led to failure and the British Company had to fall back on the United Fruit Company to maintain the guaranteed supplies. Since 1903 the latter company has held a virtual monopoly of supplies to the United Kingdom.

Paras. 33-34.—While Jamaica suffers from the absence of a " free " line to the United Kingdom the United Fruit Company have conferred an undoubted benefit on the island with their well-equipped estates, attention to water supplies sanitation and so on.

Para. 35.—The absence of a " free " line has a restraining effect on trade and is a detriment to the producer.

Paras. 36-37.—A new line to Jamaica alone would run a risk of the same disaster as occurred in 1903 and a complementary source of supply is required especially as the future of Panama disease in Jamaica cannot be forecasted.

Paras. 38-40.—The production of bananas in Jamaica is to a certain extent seasonal and at times of short production competition would arise; further, the effect of the Canadian agreement has to be borne in mind.

Paras. 41-43.—Bananas are bought by the stem and sold in the United Kingdom by the ton, therefore, quantity is important. Jamaica might show improvement in this matter. Central American bananas count 55 bunches to the ton, Jamaican 65-70 bunches. Central America gives 85 per cent. of ' count ' bunches (9 hands or more), Jamaica 65 per cent. Possibly this is in part due to Central American production being mainly on virgin soils.

Para. 44.—" We understand that in Jamaica a draft ' Produce Inspection Law ' is being prepared by the Government and that under this law produce will be inspected and the exportation of fruit in a bad condition prohibited. To such a system of regulation we attach the greatest possible value."

Para. 45.—St. Lucia and Grenada form a possible complementary source of supply.

Paras. 46-48.—Panama disease in these islands is a normal commercial risk and a total area of 5,000-7,000 acres would be necessary to give supplies required. " Assuming that such a service could be organised on the lines suggested, we strongly recommend that negotiations should be opened as soon as possible between the Government of Jamaica, the Governments of the Windward Islands, and the shipping companies who have shown interest in the matter." There appears to be an attractive commercial proposition on these lines.

Para. 49.—His Britannic Majesty's Government might assist in the establishment of nurseries. " For this purpose we would propose a grant of £2,000 to the islands and the allocation of a sum of £10,000 to be utilised as loans for the development of nurseries and the provision of suckers. Both of these sums should, we recommend, be provided out of the annual sum which the Home Government have set aside to encourage inter-Imperial trade in foodstuffs."

Paras. 50-51.—The question of the establishment of an interior service before the full supplies are obtainable and the question of the supply of cargoes is primarily a matter for the Jamaican Government.

Para. 52.—The scheme might be extended to include Dominica.

Para. 53.—The future of bananas in British Honduras depends on the discovery of a variety immune to Panama disease.

Paras. 54-55. The same remark applies to Trinidad and British Guiana. In both areas there is ample available land but in the former case there will be necessity for providing direct loading facilities.

Paras. 56-63.—The evidence with reference to Panama disease and especially the Surinam experience, justify the conclusion given in paragraphs 53-55.

Paras. 63-65.—There is the possibility that an immune form of the Gros Michel variety may be forthcoming and with the object of ascertaining the prospects of finding such, Dr. Harland was despatched from the Imperial College of Tropical Agriculture on a world tour. Delay must inevitably occur in securing results as it is not possible to import suckers direct to Trinidad from the East where diseases exist even more serious than Panama disease but unknown in the West.

Para. 66.—Other varieties believed to be immune or more or less immune are :—

Canary, Chinese, Cavendish or Dwarf.

Giant Fig, Large Fig, Junior or Cokerite.

Giant Green, Large Green or Canaan.

Paras. 67-71.—The main objection to the Canary Banana is the delicacy of the skin which necessitates packing in crates. There is every reason to suppose that, if suitably packed by hands, a successful trade could be built up but further investigation as to costs is necessary.

Paras. 72-73.—The Giant Fig is immune but the transportation used for carrying the Gros Michel is not the most suitable for this variety and further experiments on this subject are recommended.

Paras. 74-75.—Other varieties are considered including certain discovered by Dr. Harland and further investigation on these lines is recommended.

Paras. 76-77.—The arguments given indicate the need for much scientific investigation and a scheme prepared by Dr. Hill, Director of Kew, is referred to the Executive Commission with a recommendation for provision of the necessary finance.

Para. 78.—For the experimental cultivation of varieties in different islands a grant of £2,000 per annum for two or three years is recommended to each of the colonies Trinidad, British Guiana and if necessary, British Honduras.

Paras. 79-82.—The committee are convinced that "satisfactory progress can never be made unless and until the industry is welded into an organisation which is capable of negotiating and implementing contracts with shipping lines and other outside bodies while at the same time ensuring adequate representation of the interests of individual members." It strongly recommends that "the Executive Commission, in making grants to such associations, should give special consideration to the possibility of assisting the formation of associations of banana growers and exporters in the various banana exporting Colonies of the Empire," and it recommends that "grants not exceeding £1,200 a year might be made to approved organisations of banana growers and exporters in the various colonies with which we deal."

Paras. 83-86.—The committee recommends that "careful enquiries into the possibilities of banana cultivation and the likelihood or otherwise of serious disease should be undertaken in the West African Colonies without delay," and recommends that "the co-ordination of these local investigations should be undertaken by the Executive Commission."

Para. 87.—Beside the procuring of a suitable variety the following points will come up for consideration in each locality where the problem is one of starting an industry:

Provision of official and technical staff.
Acquisition and preparation of land.
Labour conditions (including supervision).
Provision of suckers.
Cultivation expenses during initial years.
Provision of internal transport.

Paras. 88 and 89 summarise the report.

H.M.L.

AFRICAN CRUISE.

THE Royal Mail Steam Packet Company has planned a second "Great African Cruise by the luxuriously equipped motor vessel "*Asturias*" which leaves New York on 15th January, 1927. The ports of call include Trinidad, Rio de Janeiro, Santos, Monte Video, Buenos Aires, Cape Town, Port Elizabeth, Durban, Mozambique, Zanzibar, Mombassa, Aden, Port Sudan, Suez, Alexandria, Naples, Monaco, Gibraltar, Cherbourg, Southampton and so back to New York. The American Express Company is co-operating in the management of all cruise features both on ship and on shore, a number of attractive optional tours having been arranged for those tourists who desire to leave the beaten track. In selecting the ports of call and in arranging shore excursions excellent discrimination has been shown. In Trinidad, for example, the tourists will be conducted over the celebrated and picturesque "saddleback drive" which will afford opportunities of viewing various cacao estates whose product is justly prized in the world's cacao markets. An attractive tour has been arranged for Santos, the world's greatest coffee port. In Zanzibar visits will be made to the native bazaars and clove groves. The reputations of the Royal Mail Steam Packet Company and the American Express Company are a sufficient guarantee that the arrangements for the comfort and pleasure of the tourists will leave nothing to be desired. The "*Asturias*" is due back in New York on 2nd April.

SUGAR MANUFACTURE.

The Oxidation of Glucose in Solution.

BY PROF. F. HARDY, M.A.

THE exact mechanism whereby glucose sugar is oxidized by free oxygen, such as occurs in air, is important and interesting if we would better understand the changes that occur in sugar liquors during their treatment in the plant-products factory. It was early suspected that the acidity of sugar-cane juice may be increased by boiling the juice in contact with air, and this change has frequently been ascribed to the generation of certain carbohydrate acids (such as gluconic acid), simpler poly-hydroxy acids, or even lactic acid, through oxidation of the glucose component of cane juice. Even *limed* sugar-cane juice becomes measurably more acid on evaporation and concentration; changes in pH value from say pH 7.2 to pH. 6.9 have been recorded during concentration in the boiling house. Indeed many sugar technologists maintain that oxidation of glucose by air takes place with more avidity in sugar liquors when the reaction of the liquid is alkaline than when it is acidic.

The formation of organic acids through glucose oxidation is significant in sugar manufacture for two main reasons. Firstly, it is believed that these acids are the precursors or the concomitants of certain humic substances that confer an undesirable dark brown colour on sugar syrups; secondly, it is known that calcium compounds of certain of these acids are responsible for troublesome frothing in stored molasses, being notably unstable, and spontaneously liberating carbon-dioxide gas among their products of decomposition.

Recent experiments in the United States have thrown considerable further light on the mechanism of glucose oxidation, and, although they were primarily performed with the object of elucidating certain metabolic changes that occur in living plant-cells, they are worthy of note by students of sugar fabrication and by technologists.

The first series of experiments to which reference will be made was performed by Messrs. H. A. Spoehr, J. H. C. Smith, W. G. Young, and P. C. Wilbur, under the auspices of the Carnegie Institute of Washington, at the Coastal Laboratory, Carmel, California. They are reported in the Year book for 1925 (No. 24, pp. 154-160) of the Carnegie Institute. Certain of their results have also been published in articles that have appeared in the *Journal of the American Chemical Society*, namely (1) "The oxidation of carbohydrates with air," H. A. Spoehr, June, 1924, Vol. XLVI, No. 6, p. 1494, and (2) "Studies on atmospheric oxidation, I, the oxidation of glucose and related substances in the presence of sodium ferro-pyrophosphate," H. A. Spoehr and J. H. C. Smith, January, 1926, Vol. XLVIII, No. 1, p. 236. The experiments will be briefly described under two headings.

1. *Oxidation of Glucose with Air.* (*Spoehr and Smith.*)

It has long been known that various metals, notably iron and manganese, play an important rôle in oxidation reactions in living plant-cells. Hence Spoehr and Smith were led to examine the efficacy of a catalyst consisting of *sodium ferro-pyrophosphate* in hastening the oxidation of various monosaccharides, disaccharides and polyatomic alcohols by atmospheric oxygen. They succeeded in proving that the catalyst acts by taking up oxygen to form sodium ferri-pyrophosphate ($Na\ (FeP_2O_7)$), which then transfers oxygen to the carbohydrate, being itself reduced to sodium ferro-pyrophosphate ($Na_2\ (FeP_2O_7)$). It was not possible to identify all the intermediate products of glucose oxidation, but carbon-dioxide was shown to be liberated in appreciable amounts throughout the process. Its rate of liberation was at first slow, but rose rapidly during forty-eight hours. These facts suggest that an "induction period" occurs during which intermediate products of oxidation are successively formed. Consequently, the rate of oxidation of a number of carboxylic acids which are known oxidation products of glucose, was next determined. Thus, *d*-gluconic acid and *l*-arabonic acids were found to exhibit very much shorter induction periods than glucose; which seems to indicate that the induction period of glucose may be due to the slowness of the oxidation of its constitutional aldehydic group.

2. *Effect of Di-sodium Phosphate on Hexose Sugars.* (*Spoehr and Wilbur.*)

During the past few years, a great deal of information has accumulated regarding the influence of *disodium phosphate* on the respiratory and metabolic reactions in plants and animals, more particularly on carbohydrate metabolism. The influence of disodium phosphate on alcoholic fermentation, on the formation of lactic acid in fatigued muscle, and on the rate of carbon-dioxide formation during respiration, have demonstrated the important rôle which phosphates play in carbohydrate metabolism. During investigations on the oxidation of carbohydrates with air, the stimulating influence of phosphates has also repeatedy been demonstrated. In order to gain information of the mechanism whereby phosphates exert these characteristic effects, experiments were initiated by Spoehr and Wilbur in an attempt to trace the effect of phosphates on *d*-glucose and on *d*-fructose. There is some evidence that glucose is converted into fructose, or into some highly active form of glucose, *before* it is fermented or oxidized; and this fact was confirmed by Spoehr and Wilbur's critical experiments. A notable feature of the reaction is that the total reducing power of the sugar solutions shows a decided decrease with time, amounting to as much as 30 per cent. in 140 days. No saccharinic acid and no acid oxidation products could be detected in the resulting mixtures at this stage, so that the conclusion follows that a *splitting* of the hexose molecule occurs, probably at the double bonds of the dienols. Accompanying the splitting, considerable "tar" formation was noted. This is ascribed to the condensation or polymerization of the products of splitting. In the presence of oxidizing or reducing reagents (such as activated aluminium) which immediately react with the splitting products, tar formation was found to be inhibited. It seems highly probable therefore that the catalytic effect of disodium phosphate in hastening the oxidation of glucose is due to the dissociating or splitting influence of this salt, and that subsequent oxidation is confined to the oxidation of the products of splitting, rather than to that of undissociated sugar. Experiments are still in progress to determine the nature of the splitting products of sugars with disodium phosphate.

As regards the possible formation of *hexose phosphoric esters* during the reactions above described, positive evidence was accumulated to show that such formation does *not* occur at ordinary temperatures (37° C.), although at higher temperatures, small amounts of combined phosphate appear to be produced.

Finally, *no* evidence was forthcoming to prove that polysaccharides are formed when hexose sugars are treated with disodium phosphate or with sodium carbonate, although certain earlier experiments by other workers were believed to have proved that both glucose and fructose are converted into polysaccharides by sodium carbonate solution.

The second series of experiments next to be considered was performed by Messrs. M. H. Power and F. W. Upson at the University of Nebraska. (See *Journ. Amer. Chem. Soc.*, January, 1926, Vol. 48, No. 1, p. 195). These investigators examined the oxidation by air of *d*-glucose in calcium hydroxide solution. Their conclusions should be of especial interest to sugar technologists, because lime is universally used in sugar-cane and sugar-beet-juice defecation.

At the outset it should be noted that, at weak alkalinities and in the absence of oxidizing agents, glucose was found to be mainly converted into other monosaccharide sugars. This result is in

accordance with that reported by Spoehr and Wilbur (*see* above), who used disodium phosphate, which is a weak alkali. Indeed, it had also previously been noted by Lobry de Bruyn (*Rec. trav. Chim.*, 1895, 14, p. 204) and by Ne (*Annalen*, 1914, 403, pp. 206, 338), who examined the general effects of alkalies on sugars. (See Armstrong, *The Carbohydrates*, London, 1924.) *The oxidation products* of glucose in the presence of weak alkali, however, had not been extensively examined by these earlier workers. Without going into the experimental details of Power and Upson's researches, their conclusions may be summarized thus :—

(*a*) Contact of glucose and lime-water for some months leads to extensive formation of saccharinic acid, as is the case with stronger alkalies.

(*b*) Among the *volatile* products of oxidation of glucose under the conditions of the experiments, carbon-dioxide and formic acid were identified.

(*c*) Among the *non-volatile* products, oxalic acid, *d*-arabonic acid, and glycolic acid were definitely identified, but the bulk of the non-volatile oxidized products was composed of unidentified hydroxy-acids.

(*d*) The following figures illustrate the relationships between the quantities of the different products obtained. 100 gr. of *d*-glucose in 10 litres of saturated lime-water was oxidized by air in 236 hours to the extent of 95 per cent., yielding 4.9 gr. of carbon dioxide, 23.1 gr. of formic acid, and 84.9 gr. of non-volatile hydroxy-acids.

Application of the results of these researches to the problems of cane-sugar manufacture.

The facts presented in the foregoing account have considerable bearing on various phases of sugar manufacture. We may indicate some of their possible applications by the following statements :—

1. The oxidation products of the glucose component of sugar-cane juices or of beet-juices, under normal factory conditions, may include a great many different and unexpected compounds. (According to Nef, any carbohydrate in weak alkaline solution undergoes profound change, but is eventually transformed into an equilibrated mixture, in which no less than one hundred and sixteen substances, can, in theory, take part.—Armstrong, p. 59.) The nature and relative amounts of these compounds will doubtless vary with slight deviations from the normal conditions that obtain in the manufacturing processes.

2. Certain components of sugar-factory liquors, such as *iron-compounds* (introduced perhaps mainly as impurities through contamination from machinery and plant), and *phosphates*, may profoundly affect the course and the end-products of glucose oxidation.

3. The *time factor* in sugar manufacture is seen to be very important in deciding the nature and significance of the oxidation products of glucose. The greater the time taken during the passage of sugar liquors through the factory, the more complex and diverse will apparently be the results of glucose oxidation.

4. The formation of *dark-coloured products* through side-reactions accompanying the process of glucose-oxidation, may largely be suppressed by the presence *at the right time* of certain reactive substances. (Among the well-known "chemicals" frequently used as decolourizing aids, stannous chloride and hydro-sulphites may possibly act largely in this way.)

5. Oxidation may be lessened or prevented by treatment of juices with excess of sulphur-dioxide at an early stage in sugar manufacture (acid sulphitation process) ; this tends to produce a permanent reducing atmosphere instead of an oxidizing atmosphere in the evaporator vessels.

6. The possibility of the fixation of phosphate as phosphoric esters of sugars at the higher temperatures realized during sugar manufacture, (particularly when phosphates are indiscriminately added to sugar liquors), should be recognized as a probable complicating factor in sugar manufacture.

7. Many disturbing elements may render doubtful the interpretation of the results of chemical analysis of sugar-factory products, and extreme caution should always be practised when employing conventional methods of examination, (especially those involving the use of Feling's solution) in attempts to explain peculiar or exceptional results that may present themselves during actual factory experience.

BANANA INVESTIGATIONS.

Professor J. Sydney Dash, B.S.A.

The investigations here discussed are a continuation of those which formed the subject of a communication to the Trinidad Agricultural Society last year, and which appeared in Vol. II, p. 144, *et seq.* of this Journal.

Date of Planting.

An experiment was laid out with the Gros Michel variety in which suckers were planted every month of the year beginning January, 1925, the primary object being to discover whether plantings could be successfully made in the Trinidad dry season, January-April, without irrigation, and from which satisfactory bunches might be produced in say twelve months time. Any results would apply generally to a variety like Giant Fig, under observation as a commercial variety, and possessing similar growth habits to Gros Michel ; the former it will be remembered usually fruits a little ahead of the latter.

So far, it has been found that in well prepared land, while there is a chance that many of the plants from carefully selected large bulbs will survive, a number will not, and those that do reach bearing stage are not likely to produce count bunches. From such plants in the College plots, only six-and seven-hand bunches have been obtained. Thus, the previous recommendations (*vide Tropical Agriculture*, Vol. II, p. 147) continue to hold good under conditions similar to those in Trinidad.

Gros Michel and Panama Disease.

During 1924, suckers of Gros Michel were obtained from every island in the British West Indies (except Jamaica) where this variety is grown, and also from British Guiana. These were tested alongside of suckers obtained from different parts of Trinidad. No traces of resistance to the disease have been discovered in any of these introductions, which have all now disappeared. In comparison, some of the Trinidad material is still standing, although it is not suggested that anything in the nature of a resistant type of this variety has been obtained here. All material, however, is being carefully observed.

Extension of Resistant Varieties.

With a view to subjecting the Grenada Giant Fig to an exhaustive study of its commercial possibilities, the area under cultivation on the College property has been increased to one acre. Other promising introduced resistant sorts such as Bumulan and Lacatan are also being multiplied as material becomes available. In addition, there is one College seedling under investigation.

The area in Giant Fig was established through sugar-cane which served as a lateral windbreak. The banana plants made healthy and vigorous growth, although on relatively poor soil (savannah land) which had only received a moderate application of farm manure, both solid and liquid. To this wind protection, along with the use of large bulbs for planting, is in a great measure due the excellent yield of count bunches that has to date been obtained from plants compared with the previous results. So far, fifty per cent. of the bunches from this new area have carried nine hands. Besides, twelve tons of cane per acre, estimated at one-third of the yield if the whole field had been under cane, was obtained. An upright growing cane is best suited for this purpose. Unfortunately, having to take off the cane during the dry season at the time of the year when the winds exert their full force, prevents the greatest use being made of this type of wind protection for ratoon banana crops; but, during the time the plant cane wind-break occupies the land, an opportunity should be taken to rapidly establish more permanent protection such as would be afforded by planting Gliricidia on the edges of banana fields. By careful pruning Gliricidia can be made to take on considerable foliage and to hold it. Further, the prunings make invaluable mulching material, thus helping to maintain organic matter supplies, which the banana plant rapidly converts into vegetation and fruit.

Cold Storage Tests.

From time to time since banana projects have been under consideration at the College, efforts have been made to send trial shipments of Giant Fig to England; but with little success, owing to the impossibility of having them carried under proper conditions. Practically all such shipments have been reported as chilled with the result that the fruit has blackened instead of ripening normally. In spite of this, a favourable report has always been received of the flavour and quality. Owing to the fact that bad impressions have been thus formed of the carrying ability of this variety, local cold storage tests were decided on, in the hope that information would be forthcoming on which to judge the utility or otherwise of proceeding further with the Giant Banana, since from the commercial point of view ability to carry and ripen attractively must be the final test.

Through the courtesy of Messrs. Furness, Withy & Co., who were interviewed by the Hon. W. G. Freeman, Director of Agriculture, Trinidad, permission was willingly granted to carry out the necessary tests at their cold storage plant. Mr. Freeman also made useful suggestions and co-operated with the writer whenever possible.

These tests were started on 18th February, when twelve bunches of the Giant Fig were placed in a cool chamber used by the above firm for storing imported fruits and other perishable articles, the temperature being taken twice daily, at 8 a.m. and 4 p.m. It soon became evident that the temperatures which ordinarily prevailed in this room, ranging between 46° F. and 53° F. and averaging 48° F. were too low at which to start the fruit, for at an early time there were signs of general blackening, any fingers with slight bruises being the first to show up. At the end of three weeks the bananas had all turned black, even those which had been removed to a warmer corridor at the beginning of the third week.

A second test was started immediately with twelve new bunches placed in the cool room on 12th March. A recording thermometer was used with this lot and the temperature kept fairly high for the first three days 65°F. was aimed at but just under 60° was the best obtainable. After this the temperature was allowed to drop and remain around 48° for the next five days. During the second week the temperature chart showed a range of between 44° and 54°, the average being about 48°. At the end of the second week the bunches were still perfectly green and in splendid condition. Four bunches were removed, two hung in a cool corridor adjoining the cold storage plant, and two others kept at ordinary room temperatures. At the end of the third week the bunches left in the cold storage showed little change in their condition, being still green. The temperature was about the same as the previous week. Of the two bunches hung in the cool corridor, one in particular ripened a normal yellow, pleasing to the eye, and the fingers at the point of attachment to the central stalk were in perfect condition. The other, while ripening reasonably well, suffered from slight bruising which detracted from its general appearance. The temperature in this ripening corridor, as was to be expected, was not so steady as in the cool chamber, and fluctuated considerably between 60° and 70°. The two bunches which were ripening at ordinary room temperature failed to come up to expectations from the point of view of colouring, but no collapse of the fingers from the stalk or marked shrinkage of the stalk itself was evident. A certain amount of shrinkage

manifested itself at the ends of the bunches, but could not be regarded, at the end of three weeks, as being prejudicial in any degree.

This second lot having given more hopeful results, due in the first place to a higher temperature at the start, it was resolved to run ano her test which was started on 22nd April. On this occasion, it was possible to include Gros Michel and the Canary Banana as well.

The programme followed much the same lines as the previous lot and the temperatures on the whole corresponded closely. After two weeks under cold storage conditions such as obtained with the second lot, all the bunches were removed to the ripening corridor previously referred to. At the end of the third week a number of the Giant Fig bunches had coloured up normally and equal in condition to the best bunch of the previous lot. So much so, that fingers were taken from all three kinds, Canary and Gros Michel included, and compared against each other, but no difference in colour could be detected at that stage. It was noticed, however, that kept at normal room temperature the colour of both Gros Michel and Canary showed up brighter, but by no means to such a degree as would exclude Giant Fig from competition with these two sorts on this count alone. Indeed, judging from the results in the ripening corridor, at room temperature of 70° F.—such as would be more likely to prevail under northern conditions—this defect, if any, would most likely not appear.

The ripe bananas were kept under observation at ordinary room temperature after removal from the ripening corridor and it was found in the case of the Giant Fig that they remained in eatable condition, although becoming dull in colour, until 19th May. This gives approximately four weeks between the date of placing in the cold storage and the last day on which they could be regarded as sound.

As a result of these trials, it would appear that the Giant Fig Banana should not be abandoned without further transportation trials suitably carried out. It should be emphasized that for the best results this variety must be carefully handled from field to ship; the slightest bruising would cause disfigurement at the ripening period, and it is from this standpoint, in the writer's opinion, that its future will have to be most carefully watched.

In respect to the time of cutting the fruit for shipment here again much care will be necessary to get it at the right stage. There appears to be a certain amount of variation in the general development of the bunches, which, unless some idea of the approximate age is known, may be cut by inexperienced persons, either too full or too young. If the latter, the fingers will remain green—although the fruit stalk may show signs of blackening rather early—and will ripen with a very insipid flavour.

Further investigations are necessary on the behaviour of the fruit in relation to the time of the year in which the bunches have been produced. Here again, indications are that a certain amount of variation in ripening and keeping qualities will be found to exist.

The writer would like to express his thanks to the Hon. W. G. Freeman, Messrs. Furness, Withy & Co., and also the staff at their cold storage plant for the very willing co-operation rendered at all times during the progress of these investigations.

THE WEST INDIAN CONFERENCE.

The West Indian Conference has just concluded its deliberations and presented its report to the Secretary of State for the Colonies. We understand that the report recommends the establishment of a Standing Conference, which would be a purely advisory body and would function in a manner similar to the Imperial Conference. It is suggested that Conferences should be held alternately in London and the West Indies at intervals of thirty months to discuss such matters as agriculture, aviation, banking, Civil Service, commerce, customs, defence, education, the Imperial College, law, marketing of produce, police force, public utility services, the tourists trade, and Trade Representation. The *ad hoc* Conferences, it is understood, will still be continued, and it is further suggested that the West Indies should be separately represented at the Imperial Conference.

In addition to reporting on the general advisability of the Conference, the delegates passed several important resolutions concerning subjects of mutual interest. In view of the grave position of the sugar growing industry of the West Indies and British Guiana, and of the high protection afforded by foreign countries to their own sugar production, it was urged that British Empire sugar should receive free importation into Great Britain, and that, should the duty on foreign sugar be reduced, compensating advantages should be given to the Empire product. Regret was expressed at the reduction of the preference on Empire cocoa from 7*s*. to 2*s*. 4*d*. per cwt., thus encouraging competition from foreign countries.

The Conference passed a resolution in favour of a separate West Indian currency and recommended the holding of a Conference to consider and make definite arrangements regarding the details. The delegates supported the appeal of Jamaica for means of marketing fruit independent of foreign corporations. The impending reduction in the steamship services between Canada and the West Indies was viewed with the greatest alarm. It was recommended that a conference should be held in order that the Governments concerned might be enabled to arrive at agreement and uniformity in respect of customs regulations and certificates, customs statistics and general classification of dutiable goods, and also to consider the question of inter-colonial trade and shipping. A visit was made to the Imperial Institute and it was suggested that a special sum should be voted to enable the West India Court to be re-organised. The question of the trade representation of the West Indian Colonies in London was also discussed, and it is understood that the various Governments will be recommended to appoint the West India Committee to organise and execute these duties for an annual subsidy of £2,000.

TROPICAL WORLD NOTES.

Ceylon.

At the annual general meeting of the Ceylon Tea Plantations Coy., Ltd., the Chairman announced that the profits for the year amounted to £332,153 eclipsing the previous record of £222,476 in 1924. Prices for tea and more especially rubber were exceedingly good. The total profit was composed of £203,273 from tea, £113,890 from rubber and £15,185 from coconuts. A dividend of 60 per cent. was declared which is equivalent to 120 per cent. to shareholders who have held their shares since 1918. The cost of production has increased 4d. per lb. since the company commenced operations but this is amply compensated for by the increased price of tea. Referring to the Ceylon tea industry in general, the Chairman stated that there were 440,000 acres under tea and any increase in crop for the next few years would have to come, not so much from new areas as from exceptionally good weather and intensive cultivation. No extensions of any importance have taken place in other tea producing countries nor is there likely to be any such development for some years. He expressed the opinion that consuming countries could absorb another 25 million lb. of tea, but as there is no likelihood of this increase the prospects for producers appear particularly favourable.

Kenya.

Sir Edward Grigg, in opening the Settlers' Parliament (the Kenya Convention of Associations) emphasised that as a result of the Governors' Conference at Tukuyu all Governments in East Africa would now speak with the same voice on the essential question of native feeling. At the Conference, he expressed the view that, "we have found ourselves in complete agreement with what is known as the dual policy laid down by the East African Commission. The dual policy means that native production and protection by European settlers are both to have the fullest opportunity in the areas which suit them best. The native must be free to choose the kind of work he may prefer." His Excellency emphasised that the main trouble with the natives on all questions, particularly labour, had been that the voice of Government had differed from time to time. "The native has been told one thing in one district, and another in another district, and has also been told different things in the same district at different times." He pointed to the experience of South Africa as showing that one could not long or successfully pursue different native policies in contiguous territories without imparing proper control by the native himself and reducing Government and production to a state bordering on chaos. In the matter of railway policy, Kenya could not afford to be indifferent to railway policy in other territories because the building of even a branch line in other territories might affect the whole basis of rates in Kenya and the whole basis of production in the highlands.

Jamaica.

Among the minor industries of the British Empire the production of honey is one of the most interesting. Considerable quantities are shipped to the United Kingdom every year from the British West Indies, New Zealand and Canada. The demand shows signs of considerable expansion, careful grading and attractive packaging being important marketing factors. The *Times Trade and Engineering Supplement* correspondent states that the oldest and probably the largest bee-keeping industry in the Empire is carried on in Jamaica from where 1,713,928 lb. of honey were shipped in 1924, practically the whole going to Great Britain. Where the climate and flora are suitable, bee-keeping offers remunerative attractions since it can be carried on with other occupations and requires very little capital and land.

British Solomon Islands.

Statistics regarding the financial position of the British Solomon Islands Protectorate, contained in the Report by the Colonial Office for 1924-25 (No. 1290), indicate that during the period now under review the Government has not been able to balance its budget. The total revenue for the financial year ended 31st March, 1925, was £64,091 6*s.* 9*d.* while expenditure reached £65,409 2*s.* 1*d.* Conditions, generally, were not very favourable in the Protectorate, the report intimating that instead of there being a decline in the high cost of living as was anticipated, there has been a slight increase. The natives are showing an interest in coconut growing, for which purpose large areas are being planted. Rice and drapery have been the principal imported articles. Though copra continues to hold its own in the front rank of exports, the quantity shipped during the year under review has fallen short of shipments during the two previous financial years. It is satisfactory to note that the birth rate has exceeded the death rate in districts where formerly just the opposite obtained. In sanitary measures the natives are gradually being educated into more cleanly habits.

Dominica.

In reply to a question asked by Captain Crookshank in the House of Commons the Secretary of State for the Colonies announced that a grant of £22,000 was being made this year to the Island of Dominica of which sum £4,000 will be by way of loan. This financial assistance is consequent upon a report made by Sir Francis Watts, Principal Emeritus of the Imperial College of Tropical Agriculture, upon the agricultural conditions of the Colony. Owing to the spread of the fungus disease known as withertip, the lime industry, the staple crop of the island has been severely damaged. It is proposed to devote £4,000 for the purpose of sending out a medical officer of health and a qualified sanitary inspector to conduct a sanitary campaign.

Ecuador.

The military revolution of July last considerably handicapped the export trade of Ecuador during 1925. Other factors, such as the exceptionally heavy rains, the dislocation of all railway communication between the coast and the interior for a period of two months, and the "witchbroom" disease which attacked the cacao crop, also affected to a great extent the cultivation and marketing of the country's produce. The correspondent of *The Times Trade and Engineering Supplement* reports that in spite of these adverse conditions the exports in comparison with previous years were fairly satisfactory. The prospects for the current year's cacao crop do not appear to be so promising. The exports of cacao during 1925 were valued at 30,892,018 sucres* ; the next most important product being coffee the exports of which were valued at 5 million sucres. The recent rubber boom has stimulated renewed interest in this industry and rubber to the value of 1¼ million sucres was exported. The cotton crop was a comparative failure owing to abnormal rains. From the *El Telegrafo*, we learn that Col. Luis T. Paz i Miño, Chief of the VIth Military Zone, recently made an interesting estimate of the total population of the country. He estimates the population of the five Provinces of the Western Tropical Zone and Galapagos Islands at 1,115,000 and that of the ten Provinces of the Central Zone, which have a temperate climate, at 1,814,000. These figures do not include the population of the two Oriental Provinces (tropical) which may exceed 100,000. The total area of the country exceeds 310,000 square miles and the population about 3,100,000. The towns, Quito and Guayaquil have over 100,000 inhabitants. Professor Kemmerer, of Princetown University, is shortly visiting Ecuador to study the financial system and report upon the advisability of going back to the gold standard.

* Sucre = Roughly 1*s*.

Hawaii.

The latest estimate of the 1926 Hawaiian sugar crop is placed at 756,600 short tons. This is made up of the Sugar Factors Company third estimate of shipping raws of 722,600 tons, an unofficial estimate of 24,500 tons of refined sugar from Honolulu plantation and 10,000 tons of "washed" sugar for local consumption. These figures were announced by A. M. Nowell, Manager of Sugar Factors Company.

An increase of 19,600 tons over the first estimate by Manager Nowell in November, 1925, is indicated. The present estimate is that the 33 plantations which send their sugar to Crokett refinery will have 613,500 tons to ship, while the other sugar which goes to the Western refinery will amount to 109,100 tons.

From the above figures it will be seen that the 1926 crop will be slightly smaller than the 1925 harvest of 776,072 tons, though larger than any other previous crop.—*The Planter and Sugar Manufacturer.*

West Africa.

Mr. W. F. Hutchinson, writing in the *African World*, states that, "whatever doubts or fears may have existed as to the wisdom or expediency of Sir Hugh Clifford's policy in granting a liberal number of the seats in the Legislative Council of Nigeria to members elected by popular vote must be allayed by the report of the interview between these elected representatives and Mr. Ormsby-Gore at Lagos." These members headed a deputation of the Nigerian National Democratic Party and laid before the Colonial Office Mission the views and policy of the Party. The Party has always been keenly critical of local administration and bold in utterance of its opinions. When the first elections resulted in a sweeping victory for the left wing of the opposition, rancorous criticism and acrimonious debates in the Council Chamber were anticipated. At the opening of the first session the elected members announced their intention of rendering every possible assistance to the Government, and this policy has been carried out with dignity and ability. The programme of the Party gives special prominence to the question of transportation, railway, motor and riverine. Stress is laid upon the cultural, economic, industrial, and administrative effect of railways and emphasis laid upon the need for greater facilities for motor and riverine transport to open up districts not directly served by existing lines, but containing some of the most extensive and prolific oil-palm forests in the country. Vigorous expression is given to their attitude towards the "plantation system" which, it is asserted, has reduced the native to a system of economic servitude which is hardly better than serfdom and made the native "a squatter, by permission, on expropriated reserves." Since the land is useless to the concessionaire without labour, a concession is inevitably followed by a demand for the driving of the native to work on the concession, which, the deputation claims, implies a substitution of a policy of exploitation for trusteeship, and a reversal of the traditional principles by means of which the West African Colonies have been governed in the past and which enabled them to enjoy the proud position they now retain as valuable units within the Imperial realm. Claims were also advanced for improved educational and sanitary facilities. Mr. Ormsby-Gore, in reply reiterated the well-known attitude of the Colonial Office by stating that the British Government would not tolerate in any part of the British Empire a policy of forced labour for private employers.

The French Government will accept from Germany only 25,000 tons of sugar on account of indemnity for destroyed area in northern France. Because of unfavourable price levels the other 50,000 tons of reparations sugars will not be accepted by the French Government at present.—*Facts About Sugar.*

THE COLLEGE.

By H. Martin Leake, M.A., Sc.D. (Cantab.), F.L.S.

The British West Indies will for ever retain a unique position within the British Empire. The reasons for this position are largely historical. Through the seas surrounding the islands, of which they are built up, lay the direct route to the Spanish main which, after the discovery of America attracted the enterprise of all nations owing to the reports of a Golden Eldorado beyond its border. It is these seas also which formed the cradle for the British navy and were for a long period a base of naval operations against the French after the Spanish dominance had been overcome. With more settled times the islands became the earliest colonies and were developed as a source of supply of sugar and other tropical produce for which a ready market was to be found in England. This early development was due to the comparatively healthy climate and to their ready accessibility by sea. Their small area raised no problems of transport such as arise in continental tracts with the healthy hinterlands isolated by a belt of fever stricken littoral. Limitations were set, however, by their size; full expansion was reached at an early date and there has been a tendency to over population which in a small agricultural community, inevitably tends to small holdings with low production. There have not, therefore, been the same openings for development and capitalistic enterprise as have been offered by the vast continental tracts lying within the younger colonies. By the development of roads and railways so characteristic of recent years the littoral tracts no longer form the same barrier to these hinterlands as of old, while advance in medical science has in large measure removed the terrors formerly found therein. It is not surprising therefore that the West Indies have failed to hold their pride of place; they have no longer the old monopolies and, except in a few cases as the St. Vincent arrowroot and Grenada's nutmegs their produce is in competition with that of more recently developed tropical areas.

But though they can no longer hold their position renewed attention has recently been directed to them Their location and accessibility has led Canada to turn to the West Indies for those supplies which are only produced in the tropics. Other incidents, such as the visit of the Parliamentary Delegation arranged by The West India Committee and the Empire Parliamentary Association and the M.C.C. cricket team, have also turned the attention of the home country to their potentialities and their wide range of beauty. The West Indies do not intend to be left in the background and, if they cannot hold their own in magnitude of production, they have determined to set an example in progress from which not only they but the whole Empire will reap the benefit.

In 1922 was founded, as the result of this enterprise, the Imperial College of Tropical Agriculture. The Scheme received the approval of Lord Milner whose name, up to the time of his death, was closely associated with the enterprise. The site forms the gift of Trinidad, in which island the College is situated and the cost of the recently completed central building is met from the funds contributed by the planting community of that island. The location of the College is ideal and the climate exceptionally healthy. The courses of instruction are wide and it is possible to study the principles and practice of tropical agriculture, the economic problems which are involved in its development and the science on which these are based. The Sugar Machinery manufacturers have presented machinery to equip a complete and well balanced Factory. Though commonly referred to as "The Model Factory" the name is misleading; it is larger than many working factories and capable of turning out two tons of sugar a day. Sugar is largely produced within the Empire yet any school of instruction, such as the American school at Audubon, Louisiana or those in Holland has been lacking. The Empire can now boast of the possession, in the Trinidad "Model Factory" with its up-to-date plant of a school and equipment second to none in the world.

The problem of health is one which has exercised a great influence on tropical development, and progress has been made in the past only at the expense of large losses of life and of human suffering. This is a disability which is rapidly diminishing. Recent medical science has shown that unhealthiness is due to definite and remediable causes and has further pointed the way to improved conditions of health in tropical climates. Tropical Hygiene and Sanitation are no longer the subject of the half amused interest of the tropical estate owner or syndicate. They are now recognised as of fundamental importance and deserving serious consideration. The health not only of the European population but of the labour force is a matter of vital importance to economic development and such subjects should form an essential part of the training of every one contemplating a career in agricultural pursuits in the tropics. Thanks to the generosity of the International Health Board of the Rockefeller Foundation a chair of Tropical Hygiene and Sanitation has recently been attached to the College and all students who pass through take a course in these subjects and in the early diagnosis of the commoner of the diseases which play havoc among the labouring community.

The courses cover a wide range and the College is open to youths over 17 years of age who have qualified for admission to any University of the Empire by passing the Matriculation Examination or an Examination accepted as the equivalent. To such youths a Diploma course of 3 years is available while Post-graduate courses of one year's duration are provided for those who have taken a degree at any University or accepted University College of the Empire. The sugar course is of 2 years duration, the first year of which is accepted as an alternative of the 3rd year of the Diploma course. Lastly, for those whose

intention it is to take up practical farming in the tropics a one-year course, adapted to suit individual requirements and selected from subjects taught is provided. It is hoped thereby to substitute for the untrained "creeper," who at present staffs so many tropical estates, a man with tropical training and experience. It is also hoped that the course will be found of advantage to those who, having sufficient capital, propose to set up independently with their own resources.

The College was opened, as has been said in 1922 and from the Diploma Course only the first students to join have passed out into the world. But already they are widely scattered throughout the Empire. The College is now represented, apart from the West Indies, in the Sudan, Uganda, Nyasaland, Rhodesia, South Africa and Ceylon. At the present time there are in residence students from The Union of South Africa, Egypt, Ecuador and Brazil, while to these countries must be added India and Ceylon whence students have been accepted for the session 1926-27. Enquiries have come from areas covering a still greater range and Australia and Malaya have to be added to the list.

There is a further aspect that has to be taken into account. Scientific and practical training are not in themselves sufficient to produce a man who will make his way and pull his weight in Empire development. Character is an all important consideration and emphatically this aspect is not neglected. What is possible is done to stimulate the development of character. While work is kept in the foreground the life of the student is rendered as free as possible. The planting community have not been backward in assistance and, through their kindness, visits to estates including week-end hospitality, are of common occurrence. In this way a great deal of practical knowledge hardly communicatable in any educational institution, is placed at the disposal of the students. The agricultural life of itself is healthy and involves outdoor work but the usual sports are encouraged. Football, including Rugby football at which the four representatives from the Union of South Africa take a prominent part, is indulged in and the College team, in spite of the present small range of selection, has acquitted itself well in the island tournaments. Lawn tennis is played throughout the year, but on hard courts owing to the presence of the noxious insect known as the "mole cricket" which destroys grass; and it is a fortunate circumstance that the land crab which, as they appear to make a speciality of digging holes in hard courts compels the use of grass in the neighbouring island of Barbados, is not sufficiently prevalent to be a nuisance. Lastly cricket, the sport of the British West Indies, is indulged in and the College can boast of one student who has played against the M.C.C. Team during its recent visit.

The work of the College, however, is not limited to its educational aspect. There is another function, that of research which is, however, so closely linked to education that it is difficult to draw a fast distinction. Advanced post-graduate education forms the link and is only adequately provided in an institution which carries the spirit of research. Research, therefore, is an essential part of the College programme not merely on its own account but because of its reflex action on education and the Associateship of the College, which is the reward for post-graduate study, is given on a thesis bases on some research problem which the student is expected to undertake. Research for its own sake and the results that it may bring is undertaken by the staff and covers a wide field. To mention a few subjects, there are at present under investigation the chemical constitution of cane juice and the changes which take place in the course of manufacture of sugar as well as the dependence of variation in that constitution on cane variety and conditions of growth; the reasons for the cultivability in the tropics of clays which would, under temperate conditions be considered uncultivable; the banana plant, especially in its relation to Panama disease a disease which has put out of cultivation large tracts in Central America; the froghopper pest of the sugar cane, an investigation being conducted in close co-operation with the Department of Agriculture under the auspices of the Froghopper Committee recently established to meet the ravages which this insect has caused in the island of Trinidad and to a lesser extent elsewhere. Such investigations as the last two raise very fundamental problems as to the true nature of disease and the causes of immunity which it is the ambition of the College to probe deeper. Lastly there is the question of cotton which has hitherto formed an important item of the College research programme. The College is situated on a tract where soil conditions counterbalance what, under other conditions, would be an excessive rainfall and the conditions are ideal for cotton. The fact has been recognised by the Empire Cotton Growing Corporation which has recently established its central research station in the same tract not a mile from the site of the College. While the more fundamental work on cotton is thus removed from the sphere of the College the two institutions will work in close touch with each other and the students, so many of whom pass to the Cotton Growing countries of the Empire, will have full facilities for studying the cotton problem in all its branches.

It is in this direction that the College forms an essential link in the chain of evolution now in progress and the British West Indies have some reason to be proud of their action in inaugurating a College which is likely, in the near future, to have such a marked effect on tropical development. Finance is now forthcoming for the opening up of the more inaccessible portions of our tropical Empire. But it is men that are required to develop the latent productivity which is there but without which the provision of transport facilities will be unremunerative.—*The Times.*

ROOT GROWTH IN THE COTTON PLANT.

Relationship to Oxygen-Supply and to Temperature of Soil.

IN the Year Book of the Carnegie Institute of Washington, U.S.A., No. 23, for 1923-24, pp. 136-8, Dr. W. A. Cannon summarizes some very striking results that have been obtained in studies of the effect of certain soil factors on the growth of the roots of cotton plants. In particular, it has been demonstrated that two factors, namely, oxygen-supply and soil temperature, are closely inter-related in their positive effects on root-growth. Thus, when the partial pressure of oxygen in the soil atmosphere is adequate (as in well-tilled soil), the rate of root-growth may be modified directly by a change of soil temperature. Conversely, when soil temperature is suitable and constant, a change in the partial pressure of oxygen, provided it is relatively ow, directly affects, within certain limits, the rate of growth of the root. In this instance, an oxygen deficiency may obtain, and soil temperature may then be the limiting factor for root-growth. Hence oxygen deficiency is merely a relative term, depending largely on soil temperature.

Further investigation of the subject suggested that, within the limits of oxygen deficiency, temperature changes operate by altering the solubility of oxygen in soil water. This indicates that the supply of oxygen at the roots of cotton plants, is in the form of a *solution* of oxygen in soil water. Thus, in a recent paper by Dr. Cannon (*Ecology*, October, 1924, v, 4, p. 319), this conclusion is presented as a generalization based on further experience with plants other than cotton (onion, lemon, maize, &c.), namely that "if the increased supply of oxygen greatly exceeds "the absorption capacity of water for the "temperature, so that both physical and physio-"logical demands are fully met, a small increase "in the oxygen partial pressure, or indeed, a "large increase, might not be followed by a "corresponding rate of growth."

The following experimental data serve to illustrate certain of the results above-mentioned :—

(1) In 8 per cent. oxygen, the rate of growth of cotton roots was normal at 25°C. but fell somewhat rapidly as the temperature was raised. At 35°C. it was about 40 per cent. normal.

(2) In 2 per cent. oxygen, the rate of root-growth was about 80 per cent. normal at 20°C. but fell to about 33 per cent. normal at 25°C.

(3) In an atmosphere containing less than 1 per cent. oxygen, growth of cotton roots was found not to take place at the higher soil temperatures, and probably not at 15°C.

(4) The critical concentrations of oxygen for root-growth in the cotton plant, lie between 1.0 and 1.5 per cent. for soil temperatures lying between 15° and 35°C.

Root-growth in Cotton in relation to soil flooding.

Recently, Dr. Cannon has investigated the direct effect of soil flooding on root-growth in the cotton plant. (Carnegie Institute Year Book No. 24, 1925, p. 296.) He has shown by experiments with sand cultures that the growth-rate of the main roots of cotton plants may be greatly decreased by flooding the soil, and that it may even cease from this cause. The result may be solely due to a sudden diminution of oxygen concentration in the soil-water accompanying flooding, whereby the oxygen-content of the soil becomes much lower than the critical partial pressure necessary for root-growth at the temperature obtaining in the environment. Doubtless these various oxygen relations in the growth of cotton roots are largely influenced by the methods of cultivation practised in the field, and cotton growers will naturally be very interested in any further results that may emanate in the future from Stanford University, California, where Dr. Cannon's researches are now being mainly conducted.

F. HARDY.

NATURAL INDIGO.

A Correction.

OBJECTION has been raised to certain statements made by Mr. L. E. Weber, regarding the natural indigo industry, in his article entitled "Is Commercial Synthetic Rubber Probable ?" which was summarized in this Journal for June, 1926, p. 118. The objection is contained in a letter written to the Editor of *Industrial and Engineering Chemistry*, June, 1926, p. 652, by Mr. C. Berkeley, of the Biological Station, Nanaimo, B.C. Mr. Berkeley states that the natural indigo industry is by no means dead, nor has it ever been entirely in the hands of the uneducated native. It is true, however, writes Mr. Berkeley, that in former years a large amount of inferior indigo was produced by native manufacturers in Southern India, but this section is now practically extinct. The greater portion and the better quality natural indigo is, and always has been, produced by planters in Northern Bihar and Orissa. It is largely due to the enterprise of these planters, many of whom are British born, that scientific aid was secured to enable them to combat the synthetic product. When the Badische Anilin und Soda Fabrik introduced synthetic indigo in 1898, the opinion was publicly expressed that in five years the natural indigo industry would be a thing of the past. As a result of scientific methods, and government assistance, however, a number of improvements were made in the agriculture and the manufacture of natural indigo and the industry survived. How far the survival will be permanent, writes Mr. Berkeley, remains to be seen. It is true that much greater interests are vested in plantation rubber than ever in natural indigo, and this is certainly a factor favouring continued prosperity in natural rubber.

F. H.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Synthetic Rubber.

Apropos of an article on synthetic rubber which appeared in this Journal for June, 1926, Vol. III, No. 6, p. 118, it is interesting to note that Prof. Fritz Hoffman, of the Kaiser Wilhelm Institute at Breslau has succeeded in making synthetic rubber from coke. During the war, German chemists elaborated a method for making synthetic rubber from potato starch. Some 50,000 tons of rubber were actually made in this way. It was necessary, however, to mix with the synthetic product a certain amount of reclaimed natural rubber. The mixture cost about six shillings a pound.

The new synthetic product costs much less than this, and is said to be superior to starch rubber. Possibly *butylin* is the initial substance employed in its manufacture. Butylin is contained in the gaseous products evolved when coal is transformed into coke. After synthesizing, the artificial rubber is worked up in such a way that it is not necessary to add natural rubber to render it plastic and elastic.

Synthetic Glass Beads.

A firm in England, the British Bead Printers of Northampton, is developing a clever invention whereby brilliantly coloured synthetic organic glass beads ("Juwella" beads) are riveted to fabrics by an ingenious process which enables the fabrics to be washed and ironed without damage. The company has world rights to this invention, and, if Juwella gowns become fashionable, a new British industry, employing organic substances, such as urea and formaldehyde as raw materials made largely from plant products, may soon be established. — From *The Spectator*, 24th April, 1926.

Viscose or Artificial Silk.

In connection with a Chemical Note recently published in these columns on the manufacture of viscose, it is interesting to learn that the first Exhibition of British Artificial Silk was opened at Shephard's Bush, London, on 24th April, under the auspices of *The Drapers' Organizer*. This marks the birth, or rather the baptism, of a new British industry, which has caused the hosiers of Leicester to rejoice, and has set the looms of Lancashire and the Midlands awhirr.

A clever Frenchman once said, "Worms produce a gum which dries into silk. Why cannot we?" It has taken two hundred years for this suggestion to materialize in the actual production of artificial silk, and it is gratifying to record that a British firm, Messrs. Courtauld's, now controls one-third of the world's output of viscose. Moreover, thirty new British viscose companies were registered last year, with a total capital of four million pounds. Twelve months ago, no artificial silk was produced in Lancashire; now there are fifty merchants dealing in it.

The manufacture of viscose involves the use of much caustic soda and other chemical materials. It takes four or five pounds of chemicals to make one pound of viscose. The viscose industry is therefore creating increased demand for chemical products, and is thus very beneficial to British chemical industries. — From *The Spectator*, 24th April, 1926.

Soil Conservation in the United States.

Leading manufacturers in United States of America have set up a National Industrial Conference Board. This has recently made it its business to enquire into the causes of the steady decline in the state of fertility of United States soils. A report made to the Board explains that, whereas some 7.6 million tons of ammonia, phosphoric acid and potash are annually removed from the soil by the principal crops, only some 3.9 million tons are returned by the farmers, together with some 1.1 million tons in the form of artificial fertilizers. This leaves an annual deficit of some 2.6 million tons, which is sufficient to cause serious alarm. Of course it is recognised that better methods of cultivation and fertilizer-usage may reduce the deficiency considerably, and in order to aid in bringing about this desirable result, it has been proposed that a new Bureau of Soil Conservation be erected, which would co-operate with the Bureau of Soils and with the Bureau of Plant Industry. The new Bureau would undertake the investigation of all phases of soil fertility, and would advise field experimenters attached to state agricultural stations. The Bureau would especially study the best means of using concentrated fertilizers, whose manufacture has recently advanced far beyond the knowledge of their correct application. —Editorial, *Indus. Engin. Chem.* June, 1926.

Potash Production in the United States.

The United States of America now possesses one of the two or three largest potash refineries in the world. This plant has recently been completed by the American Trona Corporation at Searles Lake. It is capable of producing 90,000 tons of potassium chloride and 45,000 tons of borax annually. The potash production alone is greater than that of any *single* mine in France or Germany. The borax production is the largest in the world, and supplies more than half the world's requirements.

Potash monopoly by one nation has become a thing of the past. Germany now exports slightly more than double the amount of potash than France, but she still exports all the sulphate, and about five-eighths of all the other potash salts. American potash production in 1927 will be nearly 20 per cent. of American requirements, but it is capable of further expansion.—*Indus. Engin. Chem.* June, 1926.

MOSQUITO CONTROL.

In tropical undertakings malaria is usually the greatest factor in producing non-effectiveness among labour forces and sometimes although that economic loss may be great it is insignificant compared with the outlay that would have to be expended to drain some swamp or area of water in order to prevent the breeding of the malaria-carrying anopheline mosquito, and spraying with oil to kill the mosquito larvae developing in the water is usually ineffective unless the surface of the water and the edges are cleaned of vegetation. However, there is one larvicide that is cheap and potent and acts effectively on the surface feeding anopheline larvae in areas of water covered by aquatic vegetation and algae. It is known under the names of Copper Aceto Arsenite, Paris Green or Schweinfurt green and should contain 50 per cent. of arsenious oxide.

L. W. Hackett in a monograph entitled "The Importance and Uses of Paris Green as an Anopheles Larvicide" sets forth the technique as follows :

1. *Dilution.*—Road dust is the cheapest and best dilutent for Paris Green. It should be screened and stored under cover in large quantities, since only a very dry dust can be used. If sufficient amounts cannot be obtained, wood-ashes, spoiled flour, lime, fine sand and cork dust may be substituted. Barber has recently suggested the application of Paris Green mixed with oil, since larvae will ingest droplets of oil on the surface of the water.

2. *Mixing.*—Failures are due to improper mixing as well as to inferior quality of Paris Green. Mixing should always be done mechanically in a tight box or small barrel through which an iron pipe has been run diagonally for an axis and which can be revolved like a concrete mixer. A box 30 by 30 by 50 cms. (*i.e.*: 12 in. by 12. in, by 20 in.) will serve for ten litres (nearly 18 pints) at a time.

3. *Distribution.*—This can be done by hand, throwing the mixture in the air in such a way that the wind will carry the dust cloud over the face of the water. This is the method of choice for large water areas. It is far more satisfactory with small bodies of water, to use a hand-blower or bellows of the type employed by farmers to dust vines. The blower gives a good cloud and an even spread ; the dust can be directed downwards so as to reach the water in a strong wind it automatically measures the amount of dust applied, thus cutting down waste (substitution of blowers for hand distribution at Portotorres cut down the consumption of Paris Green 50 per cent.) ; in dealing with over grown ditches and thick reeds or bushes at the water edge, the nozzle of the blower can be thrust through the encumbering vegetation and the dust delivered directly on the water instead of on the foliage of the plants ; and no special training in its use is necessary for youths in agricultural communities.

4. *Quantity.*—The tendency always is to use too much. This is corrected by demonstration, by use of mechanical blowers for distribution and by restricting the amount of Paris Green in the mixture to one per cent. The object is larvae destruction, and it seems impossible to apply even a one per cent. mixture so lightly as to fail to secure this result. An exception is water covered with scum, which sometimes requires considerably larger amounts. A stronger mixture than one per cent. might be used in case diluent material were very scarce, or had to be transported long distances at great expense. It is not necessary to use more than one-tenth c.c. ($1\frac{1}{2}$ grains) of Paris Green to the square metre (roughly 1 sq. yd.) under any conditions of obstructing or protective vegetation. Thus a litre (1,250 grams or 1 4-5th pints) of Paris Green should control breeding over 10,000 square metres (*i.e.*: approximately $2\frac{1}{2}$ acres of surface or along 10 kilometres ($6\frac{1}{2}$ miles) of bank. The intervals between treatments should be shor er than the period required for Anopheles pupae to develop in that season and for that species.

5. *Precautions.*—The persons who distribute Paris Green suffer no ill effects if they take ordinary care to keep to windward of the dust cloud, change their outer clothing at the end of the work and wash their hands before eating.

We had an occasional complaint of headache and diarrhoea in the first few days of our work in the period of hand distribution, but none in recent months. No skin manifestations or burns were reported to us.

With regard to the water treated, it has been established that Paris Green in quantities destructive to anopheline larvae does not kill culicine larvae except in very shallow pools, and these, if present, may be used as a rough index of safety. Paris Green does not harm fish of any kind (including *Cambusia affinis*) or domestic animals or vegetation.

6. *Cost.*—The cost in Italy, inclusive of labour worked out at about 10.20 lire (48 cents or 2*s*.) per 1,000 square metres (approximately $\frac{1}{4}$ acre) of water surface.

E. A. S.

ADVERTISEMENTS.

Mr. Henry H. R. Mole, of Little Neck, Long Island, New York, has been appointed advertising agent for *Tropical Agriculture* in the United States of America and Canada. All communications from those countries respecting advertisements should be addressed to him. The address of our advertising agent in the United Kingdom is 14, Trinity Square, London, E.C.3. Firms in the West Indies and British Guiana are requested to address their communications to the Editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad.

RAILWAYS IN BRITISH GUIANA.

WITH the great interest which has been raised locally in connection with the proposed railway to the interior, Mr. S. H. Bayley's able and interesting paper on the historical development of railways in British Guiana may be considered to have been published at a most opportune moment. The first iron railway in the world, operated for general purposes, was opened in September, 1825. It is interesting to note that in March, 1837—only eleven and a half years later—a definite effort was made to form a Company to build and operate a railway between Georgetown and the Mahaica River on the East Coast of Demerara. Stress was laid in the prospectus upon the approaching emancipation of the slaves and the substitution of machinery and railways as the only means of salvation. Apparently the cost of construction was estimated at £4,500 to £5,000 per mile, but the necessary capital was not forthcoming and the project fell through.

In 1845 the question was again raised, the prospectus referring in optimistic terms to the "level country and other physical advantages" for the construction of the proposed railway, and predicting that the line would pay dividends of 10 per cent. per annum. The Committee in London raised the capital from £100,000 to £200,000 but eventually Ordinance No. 2 of 1846 fixed the capital at £250,000 in 10,000 shares of £25 each. In 1847 some four miles had been laid. In 1848 financial troubles became acute owing to pressing liabilities and heavy overdue "calls" attributed to the distress of the West Indian proprietors and merchants who constituted the great majority of the shareholders. Eventually in 1850 a loan of £50,000 was authorised by the local Legislature, interest being fixed at 6 per cent. and a mortgage on the undertaking including the works, lands, holdings, &c., was given as security. The subsequent history of the line was a very chequered one and the line to Mahaica was not completed until 1864. The cost of constructing the railway, 21½ miles in length, is said to have amounted to £313,000. Almost immediately a suggestion was put forward for the extension of the railway to Blairmont on the West Bank of the Berbice River. This portion was eventually built during 1897-1900 at a cost of £265,044, the length being 39 miles. A West Coast line to Greenwich Park, a distance of fifteen miles, was also constructed at a cost of £101,940 and was extended to Parika (3½ miles) in 1914 for £16,390. These extension lines never paid their way and owing to the extreme dissatisfaction with the service provided, the Government appointed a Committee of the Combined Court in 1918 to enquire into the train service and report as to the advisability of the colony acquiring the property. As a result the Government decided to purchase the Railway and the Colonial Transport Department assumed control on 1st January, 1922. British Guiana claims the distinction of having constructed the first railway on the South American Continent.

EMPIRE COTTON.

THE preliminary report to the Council of the British Cotton Growing Association on the cotton industry in the East African Colonies by Mr. W. H. Himbury, the Superintendent reviews the conditions in connection with cotton growing in these places. Mr. Himbury has recently paid an extensive visit to the East, his itinerary including Kenya, Tanganyika, Uganda, the Sudan and India. In Kenya cotton does not occupy a principal place in the crops grown and it is not expected that it will develop to become the principal agricultural industry. The production of maize and the existence of excellent pasturage being the basis for the development of an export industry in meat, and in addition wheat, coffee, sisal, barley and flax may be expected to become crops of considerable importance for export. The lack of native population which can be depended on as labour for the extension of agricultural industries is considered to be a drawback, and the remedy for this state of affairs is thought to be an increase in the European population and the introduction of agricultural machinery.

Tanganyika formerly German East Africa, is now administrated by the British under a Mandate. The development of the cotton industry in recent years has been considerable. The production of cotton lint in 1922-23 was nearly 3 million pounds, and in 1924-25 about 7½ million; of these amounts the native production in 1922-23 was 1,229,000 pounds, and in 1924-25, 4,714,000 pounds.

Mr. Himbury expressed himself as being very disappointed with the lack of roads and the very poor condition of those which he found, and considers it one of the first duties of the Government to spend money on the construction and improvement of its roads since these will be needed as feeders, for the railway if, and when, it is developed.

The principal exports of the Mandated Territory are sisal, ground-nuts, coffee, cotton, copra and hides and in respect of all these crops there has been an increase in the amount exported in recent years. The Bukoba district is particularly a coffee producing area and it is not expected that cotton cultivation will greatly increase in this district. Mwanza and Tabora are the two areas in which it is expected that the chief development in cotton growing will take place.

Mr. Himbury's report on his visit to Uganda gives the chief products of this colony as cotton, coffee, ground-nuts, chillies and hides. Cotton represents 90 per cent. of the exports and easily heads the list. In 1924 cotton exports amounted to 514,418 centals valued at £3,486,565 as compared with 352,148 centals in 1923; 193,159 centals in 1922; 325,463 centals in 1921 and 208,746 centals in 1920. In 1925 the exports were 784,152 centals having a value of £4,685,192 equal to 91.4 per cent. of the total exports. The cotton seed exported in this latter year was 21,928 tons to the value of £122,790, raising the export

value of the cotton crop to 94.35 per cent. of the total exports. Coffee exports amounted to 2.74 per cent. and rubber 1.35 per cent. of the total exports.

The remarkable growth of the cotton industry in Uganda is said primarily to be due to the energy and enthusiasm of the demonstrative officers who encouraged the people to grow the crops and thus to enjoy a very great measure of prosperity. A tribute is also paid to the excellent work of the Agricultural Department which although ill-equipped and under-staffed has been very prominent in the efforts to improve the condition of the native population and increase the output of saleable crops.

The roads in Uganda are said to be the best seen by the writer in any of the tropical possessions visited and in consequence of good roads a very considerable amount of motor road transport is available for the handling of agricultural products.

Speaking of the railways, Mr. Himbury points out that railway traffic has been badly congested and quite unable to deal with the cotton and cotton-seed from Uganda with anything like despatch, although it is only fair to say that the quantity of cotton moved out of the country in the first three and in the first six months of 1925 was 50 per cent. more than in the corresponding period of any previous year. The matter of handling and storage of cotton at railway receiving depôts needs consideration, and in the movement of such a large crop there should be a spirit of co-operation developed between all the parties concerned in its movement from the ginneries to its market.

Railway development is attracting attention and Mr. Himbury is of the opinion that the authorities cannot go far wrong in constructing railways almost anywhere in Africa but that first consideration should be given to meeting the requirements of those districts in which traffic is already available for handling, and that lines required to open up new countries should be developed later.

In referring to the agricultural staffs, it is pointed out that the Uganda Agricultural Depar ment has never been over-staffed but that the addition of fully trained men from the Imperial College of Tropical Agriculture of Trinidad has very materially improved the situation. In connection with the training of students for positions in such places as Uganda, Mr. Himbury suggests that while students trained in research are very essential for forming a research staff it is desirable that others having general agricultural training would also be very useful; and the employment of a sufficient number of general agriculturists will tend to leave the research students freer to prosecute their enquiries and less liable to be called on to do the work of agricultural instructors to the natives.

Mr. Himbury found that the seed farms in Uganda were doing well and that a good quality of cotton was being produced by them, but he was of the opinion that when the cotton-seed was being distributed for native cultivation there should be European Agricultural Officers available for watching the whole season's progress from the distribution of the seed through planting and cultivating to the picking and ginning in order that the proper steps might be taken at the right times in the field, and that the crop might be kept under proper observation when going through the ginneries in order that the seed might be kept free from mixing. It is also suggested that larger ginning stations might be established and a more economical working effected that is now the case with a very large number of small plants operating independently.

The Government control of the cotton industry had made possible the very extensive and very rapid growth of the industry and it was believed that this control should be maintained for a while longer in order that the interests of the small grower might be fully protected in every way. On the whole it was felt that the yield of cotton was rather low, but that it was possible to increase it very materially. The quality of Uganda cotton is good. The staple varies in length from 1-1/8 inches to 1-3/16 inches.

The soils of the country vary from not very fertile to very rich and deep; this variation of soils gives opportunity for variety production. Implemental tillage is becoming more common and animal drawn ploughs are coming into use. One firm is said to have sold one thousand ploughs in a season. The ploughs are drawn by one or two pairs of oxen and in some instances the enterprising native owning a plough and the necessary animal for drawing it undertakes ploughing work for others who are without these advantages. Although Mr. Himbury found an undoubted shortage of labour in Uganda he also found a great wastage of labour. The wastage was due to the fact that labour appeared to be cheap; 8 to 10 able-bodied men pushing and hauling a cart through the streets was certainly a wastage when double the amount of the load could have been transported in a Ford or other van. Similar wastage of labour was observed in nearly every line of industry, and it seemed that if all employers of labour could be convinced that cheap labour is not always an economic advantage and labour saving devices introduced wherever possible much labour might be released from unprofitable employment and made available for agricultural and other developmental work.

In speaking of the outlook for the future Mr. Himbury found this to be good. It was felt that the policy should be to increase the production of cotton by increasing the yield rather than by extending the acreage; an increase in the crop in many places of from 3 to 5 per cent. seemed probable without the planting of a single additional acre.

H.A.B.

COLLEGE NEWS.

The Principal returned to Trinidad on the 19th June, by the s.s. *Carare*.

Mr. C. T. Watts, technical assistant, returned to Trinidad on the 29th June, by the s.s. *Dominica*.

Professor Dash, accompanied by Mrs. Dash and children, sailed for England on the 29th June by the s.s. *Bayano*, on vacational leave.

Captain H. V. Metivier, O.B.E., lecturer in Veterinary Science, accompanied by Mrs. Metivier and children, sailed for England on the 13th July, by the s.s. *Camito*.

Messrs. I. E. James, B. G. Owen, S. R. de Villiers, J. C. Haigh, and F. E. Kenchington, post-graduate students, sailed for England on the 6th July by the s.s. *Crynssen*.

Among the visitors to the College lately have been, Captain Robson, R.N.R., of the s.s. *Hughli*; Professor Rogers of Trinity College, Hartford, Conn., and Messrs. G. Bosse and S. Bukasov of Russia.

Messrs. Cheesman and Turner, lecturers in Botany and Chemistry, sailed for England on vacational leave on the 22nd June. Messrs. Miller and Guest, post-graduate students sailed for home by the same opportunity.

Dr. S. C. Harland has resigned the post of Professor of Botany and Genetics at the College, to take up the appointment as Head of the Department of Genetics on the Staff of the Cotton Research Station of the Empire Cotton Growing Corporation.

Dr. J. S. Dunkerly who is spending the long vacation at the College has lately held the position of lecturer in Parasitology at the Glasgow University, which post he has now resigned to go to the University of Manchester, where he will assume the duties of Professor of Zoology and Director of the Museum. Dr. Dunkerly has come to Trinidad for the express purpose of making a study of the protozoan parasite of the termites and incidentally of the internal parasites of other insects, particularly the Orthoptera.

The Sessional Examinations were concluded on the 25th June. The following students passed their 3rd Year Examination and have become eligible to receive the College Diploma:

Mr. J. G. Davies
,, H. L. Huggins
,, H. B. Springer (1st Division)

The following students passed their 2nd Year Examination:

Mr. J. A. McDonald
,, J. A. Potter
,, R. M. Steven

The following students have passed their 1st Year Examination:

Mr. N. Aspiazu
,, F. McG. Bain
,, L. S. Birkett
,, A. C. G. Palmer
,, G. E. L. Spencer

BOOK REVIEWS.

PALGRAVE'S DICTIONARY OF POLITICAL ECONOMY.—Edited by Henry Higgs, C.B., Vol. III N-Z, Lond.: Macmillan & Co., 1916, pp. xxii+849. Price 36*s*. net.

This book was last reprinted in 1918 and in the present edition pages 1 to 691 have been printed with slight modifications from the original stereotyped plates. In the preface the Editor explains that to have reset the type of this part of the Dictionary would have necessitated a prohibitive price for the volume. Additional articles and continuations of original articles have therefore been included in an Appendix of 120 pages. The older portion of the present volume secured such a well-merited reputation that it would appear unnecessary to accord it any additional encomium within these columns. The appendix is an admirable example of brevity combined with clear exposition which worthily maintains the high standard of previous editions. While the Dictionary does not pretend to include within its scope the latest economic statistics, the innumerable uses of such a book of reference render it the indispensable companion of every economic student.

C. Y. SHEPHARD.

AN INTRODUCTION TO STATISTICAL METHODS.—By Horace Secrist, Ph. D., Professor of Economics and Statistics, North-Western University, New York. The Macmillan Company, 1925, pp. xxxiii+584, price 16*s*. net.

This book was first published in 1917 when it earned a reputation as one of the best elementary books on the subject of statistics. For the present edition the matter has been entirely rewritten and enlarged, and represents in many ways an advance upon the previous edition. It is intended for the use of college students, statisticians and business executives. Perhaps the most conspicuous feature of the treatise is the arrangement of the first few chapters which deal with the sources and methods of collecting statistical data, and explanation of units of measurement, classification, tabulation and presentation. There is no evidence of the undue haste to arrive at results before the method has been thoroughly described which is the characteristic of so many modern text-books on the subject. While this repetitive style is well adapted to suit the requirements of students approaching the subject for the first time the inordinate length may prove a little tedious to the more advanced student. The treatment of correlation and index numbers is good. There are a few rather surprising omissions which are probably due to the evident desire of the author to stress the elementary aspect of the science. On the whole this book forms an excellent introduction to the science, the style being especially well adapted to suit the needs of college students.

C. Y. SHEPHARD.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility or the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Stocks of sugar generally have shown an increase during the year, a factor which tends to favour buyers. It is stated, however, that consumption has not decreased. The weather has been unfavourable for the sowing of beet in spite of which Poland, France, and the United Kingdom have added to their acreage. Czechoslovokia, Germany, Holland, Denmark and Roumania, on the other hand, show reduced areas. Best Granulated and Muscovado have maintained the advances recorded in our last issue remaining at 30*s*. and 22*s*. 6*d*. per cwt. respectively, duty paid, on 16th June. Cubes suffered a decline from 33*s*. 9*d*. to 33*s*. per cwt., the price for the last three weeks remaining at the latter level. West Indian Crystallized also declined from 26*s*. 2d. to 25*s*. 9*d*. per cwt. Cabled reports of 12th July record foreign sugar of 96° c.i.f. at 11*s*. 9*d*., preferential of 96° c.i.f. at 15*s*. 3*d*. and Yellow Crystals landed, duty paid, at 24*s*. 9*d*. to 26*s*. each per cwt. In New York Cuban sugar 96° c.i.f. was reported at $2.38 per 100 lb. on the same date.

COTTON.—Since our last report prices have shown a sharp decline caused in the main by reports of favourable weather conditions in the cotton belt and the continuation of the coal strike in England. New low levels of prices for the season have to be recorded the price on 17th June being 9.54*d*. per lb. for Middling American.

CACAO.—All types of cacao have experienced rises in price since our last issue. Ceylon Ordinary rose from 102*s*. 6*d*. on 26th May to 107*s*. 6*d*. on 16th June, Trinidad Mid Red from 70*s*. on 26th May to 75*s*. on 16th June. Grenada Fine from 57*s*. 6*d*. on 26th May to 62*s*. 6*d*. on 16th June, and Accras from 43*s*. 9*d*. on 26th May to 47*s*. 6*d*. on 16th June, each per cwt. For Accras, August delivery, 49*s*. per cwt. is firmly demanded. Cabled advices report Trinidad L.L.T. at 72*s*. to 73*s*. per cwt. in London on 12th July, and Grenada L.L.T. at 68*s*. per cwt. on the same date. In New York the corresponding prices are 15¾ cents and 14½ cents per lb. respectively.

COFFEE.—The market remains firm for spot sales but shows indication of weakness for futures. Jamaica Blue Mountain has remained steady since our last report at 205*s*. per cwt. Costa Rica Middling advanced from 160*s*. on 26th May to 165*s*. per cwt. on 16th June and has succeeded in maintaining this rise. Kenya Good Middling similarly rose from 115*s*. to 120*s*. per cwt., and Brazil Santos from 100*s*. to 105*s*. per cwt.

TEA.—Prices in general have shown a slight decline but considerable business has been done. Average prices for Ceylon and Indian declined from 22.28*d*. to 20.69*d*. and from 21.00*d*. to 19.98*d*. respectively, each per lb., from 19th May to 16th June. During the same period Java tea rose from 16.85*d*. to 7.74*d*. but subsequently declined to 17.16*d*. on 16th June.

RUBBER.—Since our last issue the market remained dull and inactive, a condition which was reflected in lower prices. During the week ending 17th June, however, prices showed a firmer tendency with a slight rise in price. First Crêpe changed hands at 1*s*. 9*d*. and Ribbed Smoked Sheet at from 1*s*. 8¾*d*. to 1*s*. 9½*d*. per lb.

COPRA.—Sales of Copra have been good and prices have hardened. F.A.Q. Ceylon to London rose from £30 7*s*. 9*d*. per ton, on 19th May to £31 5*s*. on 16th June. Sun-dried Straits to Rotterdam after declining from £29 17*s*. 6*d*. on 19th May to £29 10*s*. on 26th May later rose to £30 on 9th June at which price it has since remained. Straits to Marseilles declined from £29 2*s*. 6*d*. on 19th May to £28 15*s*. on 26th May, but subsequently rose to £29 on 2nd June and remained at that price during the succeeding two weeks.

GROUND-NUTS.—Prices have continued their upward tendency without, apparently, affecting demand. Nigerian nuts rose from £22 5*s*. per ton on 19th May to £24 on 16th June while Chinese rose from £21 15*s*. to £23 15*s*. between the same dates.

PALM KERNELS.—Considerable business in West African palm kernels has been transacted since our last report, prices rising to £21 6*s*. per ton.

FERTILISERS.—Nitrate of Soda declined by 3*d*. to 13*s*. 3*d*. per cwt. but Sulphate of Ammonia and Sulphate of Potash have remained at 13*s*. and 11*s*. 3*d*. per cwt., respectively.

PALM KERNEL OIL.—The market for palm kernel oil remains in a healthy and active condition. Lagos sells at £39 and Dahomey at £38 10*s*.

RICE.—Carolina rice rose by 10*s*. to £40 10*s*. per ton and Burmese also rose 10*s*. to £16 5*s*. Patna rice hardened from £23 to £32 10*s*. per ton. These rises have been well maintained.

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